

# LM9702 Real Time Digital Image Processor

## General Description

The LM9702 contains all functions needed to build a VGA digital still and/or video camera. It incorporates a 16 bit RISC microprocessor, a flexible image processing pipeline, hardware JPEG compression, and the required periphery modules in a single IC. This architecture allows a very fast click-to-click time and full resolution video without sacrificing image quality or cost; because the computation extensive operations are processed by circuitry dedicated to image processing. The highly optimized memory management provided by the LM9702 keeps the memory cost of the complete camera to a minimum.

A chip set comprising of the LM9702 and a National VGA CMOS image sensor complemented by a lens, battery, compact flash, power management for the battery, and LCD (optional) yields a complete high performance cost effective digital still and/or video camera.

## Features

- Embedded 16 bit RISC processor system
  - Up to 16M-bytes of external memory addressing space
  - 16K-bytes Internal RAM
  - 6 channel DMA
  - 8 channel versatile timer
  - Interrupt controller
  - 16 input wake up module
  - Full duplex USART
  - $\mu$ wire/SPI serial port
  - 16 general purpose IOs (GPIO)
  - SD Memory Card Interface (SPI Mode)
- Glueless CMOS image sensor interface
- ACCESS.bus serial interface for imager sensor control
- Integrated USB v1.1 for connection to PC
- Raw Image Data Processor
  - Defective pixel correction
  - Digital gain and brightness adjustment
  - Raw data statistics measurement engine
- Color Image processing
  - Bayer to RGB Interpolation
  - Fully programmable color correction
  - Image sharpening
  - Programmable gamma correction
  - Thumbnail generation
  - RGB to YCrCb Conversion
  - Digital Gain
- Hardware JPEG Compression for both video and snapshot
- System management
  - Internal Clock generation from 12MHz Crystal
  - Power management
  - Reset generation
- JTAG based serial on-chip debug interface

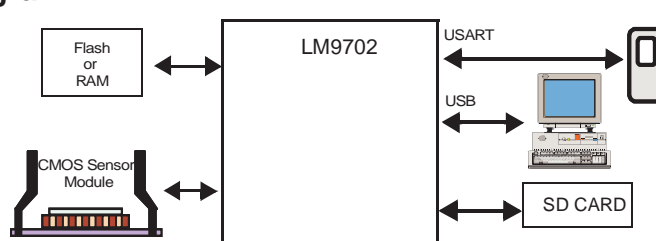
## Applications

- PC Cameras
- Dual Mode Cameras
- Digital Still Cameras
- Clip-on Cameras for PDA's, Cell Phones, etc.
- Embedded Cameras for PDA's, Cell Phones, etc.
- Industrial Cameras

## Key Specifications

Array Formats	CIF,VGA, SXGA (B/W)
Input Color Format	Bayer Pattern
Digital Image Processor	10 bit (12 bit internal)
Compression <ul style="list-style-type: none"> <li>- Format</li> <li>- Ratio</li> </ul>	Base Line JPEG Programmable
Video In Frame Rate	up to 15MHz pixel clock
Video Outputs <ul style="list-style-type: none"> <li>- USART</li> <li>- USB</li> </ul>	up to 921.6K-bits per second 960K-byte/s
External CR16C Memory <ul style="list-style-type: none"> <li>- Memory Type</li> <li>- Address Space</li> <li>- Speed</li> </ul>	SRAM, Flash, Compact Flash, EEPROM up to 16 Mbyte up to 36MHz
Serial Interfaces <ul style="list-style-type: none"> <li>- ACCESS.bus</li> <li>- <math>\mu</math>wire/SPI</li> </ul>	up to 400KHz up to 6.0 MHz
16 bit RISC Processor <ul style="list-style-type: none"> <li>- MIPS</li> <li>- Internal Memory</li> </ul>	up to 36 16K-bytes
Clock Speed	up 60Mhz from 12MHz Crystal
Power Supply <ul style="list-style-type: none"> <li>- Core</li> <li>- IO</li> </ul>	2.25 to 2.75 Volt 2.7 to 3.6 Volt
Average Power Dissipation	90mW
Package	128 Laminated CSP
Operating temperature	-10°C to +85°C

## System Block Diagram



## Overall Chip Block Diagram

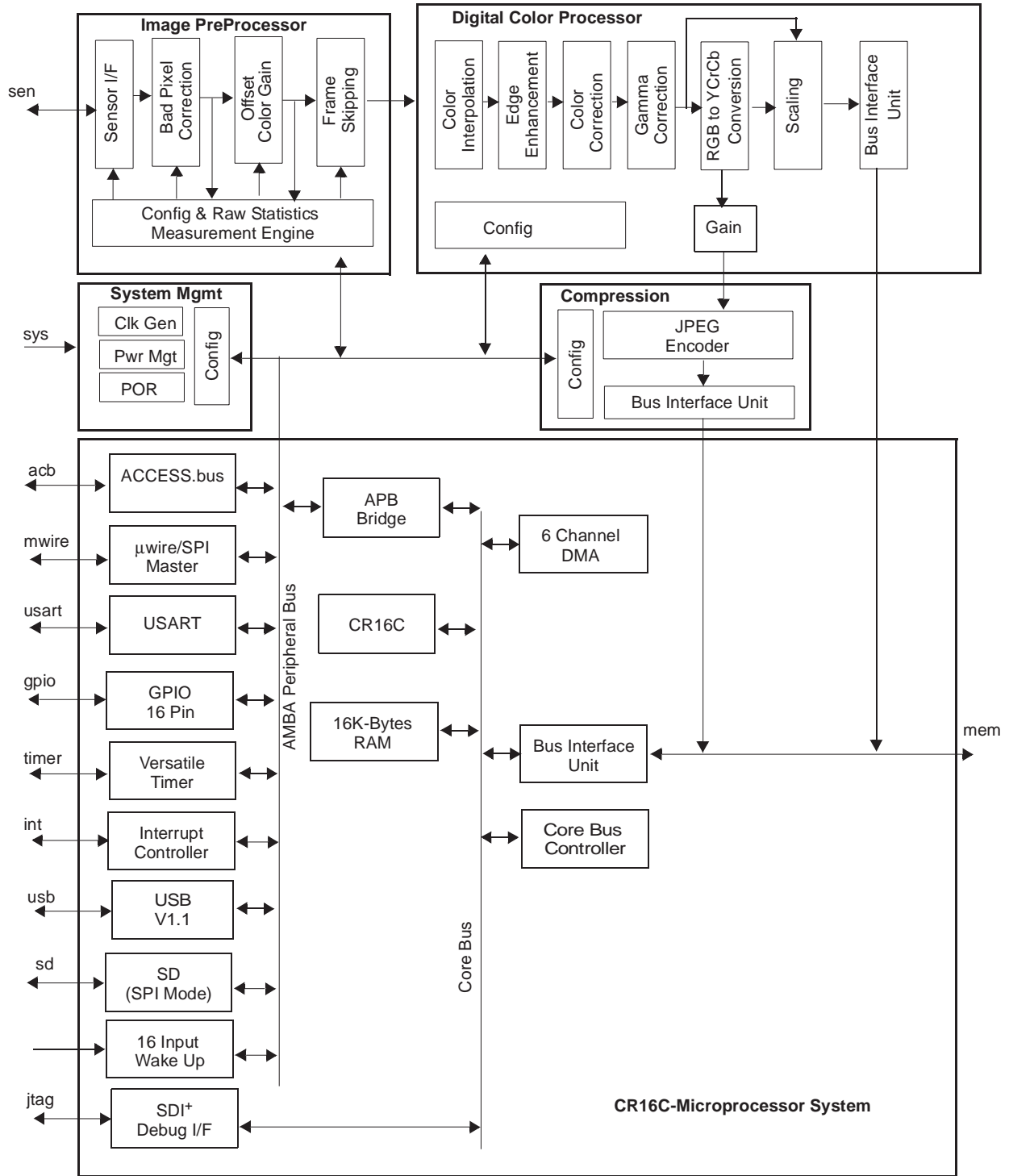


Figure 1. Chip Block Diagram

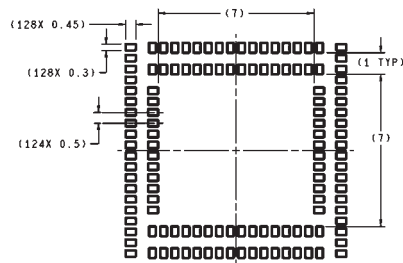
## Ordering Information

Item	Description	Part Number
LM9702	LM9702 Digital Image Processor with Integrated Pipeline	LM9702SL

## Related Products

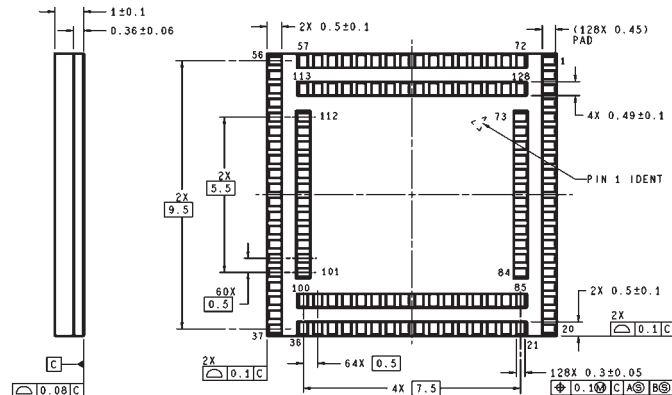
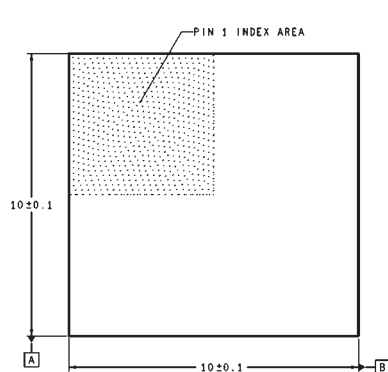
Item	Description	Part Number
Development Kit	LM9702 digital image processor camera development kit. This kit includes the above mentioned camera base board, a power supply board, status LCD board, power adapter, windows application software SNAPS DEV.	LM9702DEV-KIT
Camera Board	LM9702/04 digital image processor camera base board.	LM9702CAMBOARD LM9704CAMBOARD
Software Development Kit	This kit includes CR16C software development tools, National's Camera Operating System (NCOS) & an iTAG emulator.	CR16-IM02-00
Compact-Flash Adaptor	This is a small 16 bit CompactFlash adaptor board that can be attached to the LM9702CamBoard/LM9704CamBoard allowing CompactFlash cards to be connected to the main system memory bus	LM97COMPACFLASH
SD/MMC Adaptor	This is a small SD/MMC adaptor board that can be attached to the LM9702CamBoard/LM9704CamBoard allowing SD and MMC cards to be connected to the LM9702/LM9704 digital image processor	LM97SDCARD
Head Boards	VGA color sensor LM9627 VGA monochrome sensor LM9617 VGA color sensor LM9628 VGA monochrome sensor LM9618 128x100 monochrome sensor LM9630 VGA monochrome sensor LM9637 VGA color sensor LM9647 SXGA monochrome sensor LM9638 SXGA color sensor LM9648	LM9627HEADBOARD LM9617HEADBOARD LM9628HEADBOARD LM9618HEADBOARD LM9630HEADBOARD LM9637HEADBOARD LM9647HEADBOARD LM9638HEADBOARD LM9648HEADBOARD
Lens Kits	1/3" lens kit for the LM9627, LM9617, LM9628 or LM9618 1/5" lens kit for the LM9630 1/4" lens kit for the LM9647, LM9637 1/2" lens kit for the LM9648, LM9638	LM96-1/3LENSKIT LM96-1/5LENSKIT LM96-1/4LENSKIT LM96-1/2LENSKIT

## Package Information



RECOMMENDED LAND PATTERN  
1:1 RATIO WITH PACKAGE SOLDER PADS

DIMENSIONS ARE IN MILLIMETERS



SLB128A (Rev B)

## LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



**National Semiconductor Corporation**  
Americas  
Tel: 1-800-272-9959  
Fax: 1-800-737-7018  
Email: support @ nsc.com  
tional.com

**National Semiconductor Europe**  
Fax: +49 (0) 1 80-530 85 86  
Email: europe.support @ nsc.com  
Deutsch Tel: +49 (0) 69 9508 6208  
English Tel: +44 (0) 870 24 0 2171  
Francais Tel: +33 (0) 1 41 91 8790

**National Semiconductor**  
**Asia Pacific Customer**  
**Response Group**  
Tel: 65-2544466  
Fax: 65-2504466  
Email: [ap.support@nsc.com](mailto:ap.support@nsc.com)

**National Semiconductor  
Japan Ltd.**  
Tel: 81-3-5639-7560  
Fax: 81-3-5639-7507